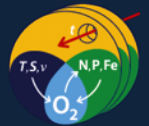


PREFACE-PIRATA-CLIVAR Tropical Atlantic Variability Conference
UPMC, Paris, France
November 28, 2016



SFB 754

Collaborative Research Center 754 | SFB 754

Potential impact of Atlantic climate modes on the ventilation of the oxygen minimum zone in the eastern tropical north Atlantic

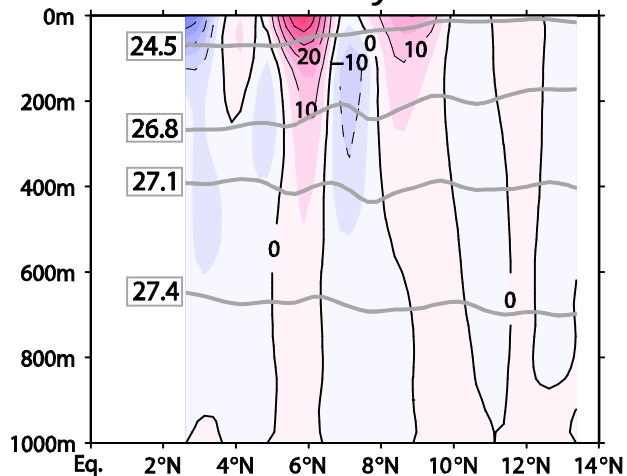
Kristin Burmeister¹ and Joke Lübbbecke^{1,2}

¹GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany

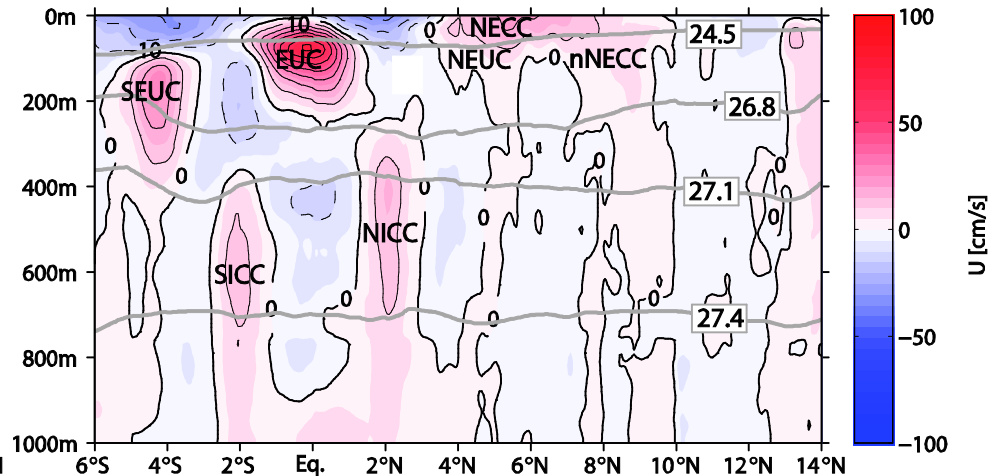
²Christian-Albrechts-Universität zu Kiel, Germany

23°W section

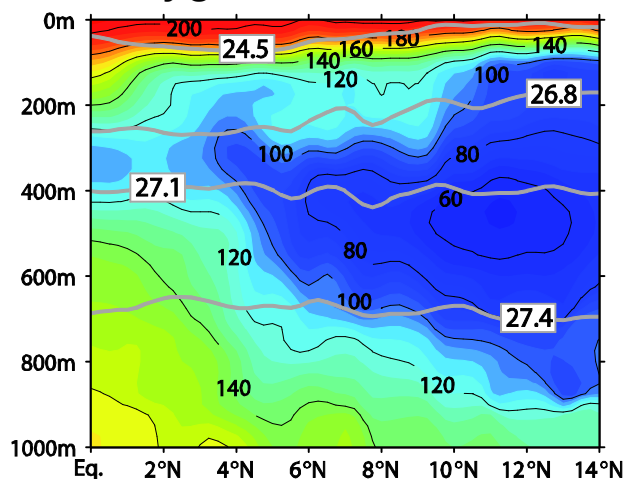
Zonal velocity 1972-1985



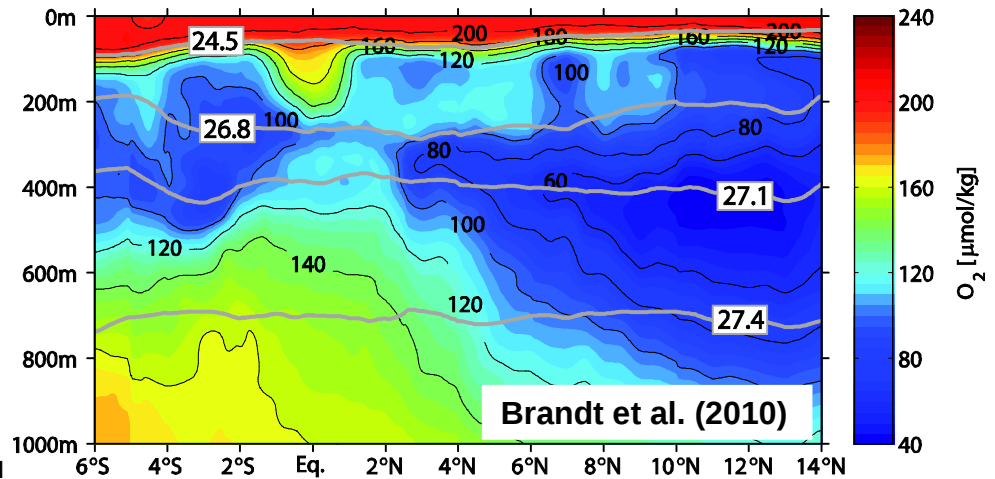
1999-2008



Oxygen 1972-1985



1999-2008



Brandt et al. (2010)

Introduction:

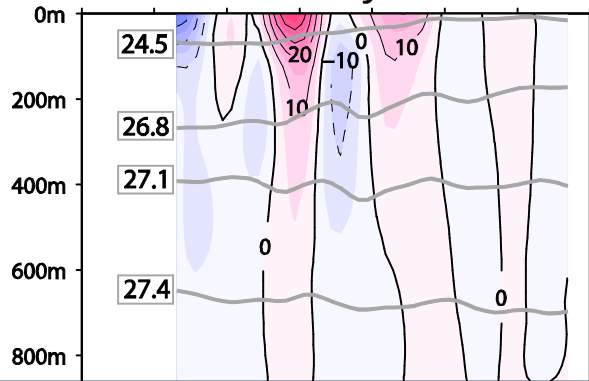
The oxygen minimum zone in the eastern tropical North Atlantic



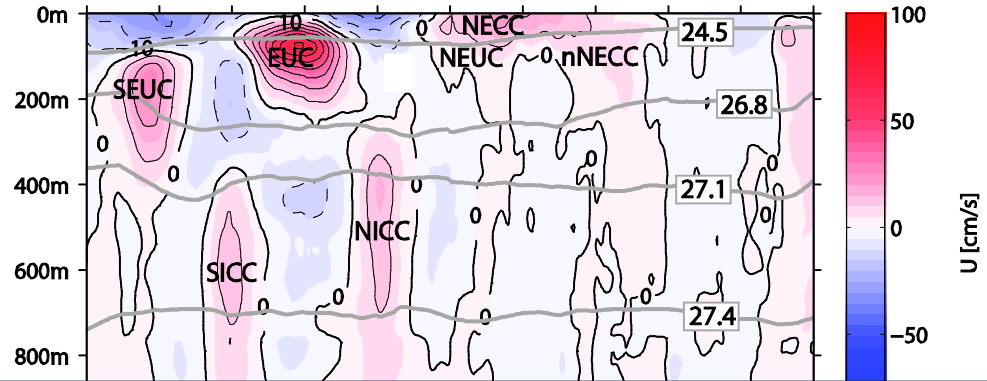
SFB 754

23°W section

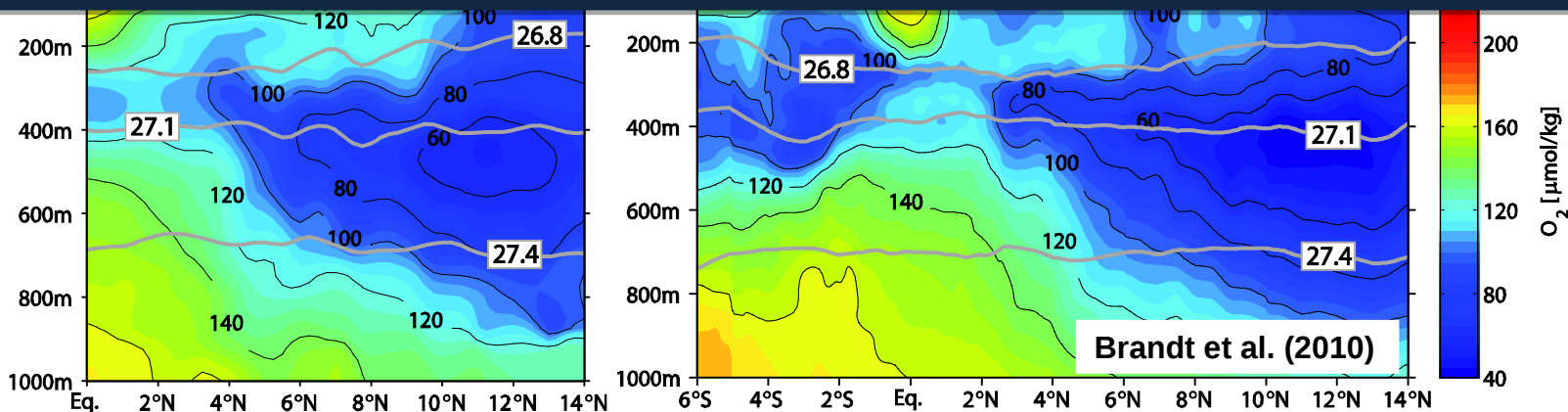
Zonal velocity 1972-1985



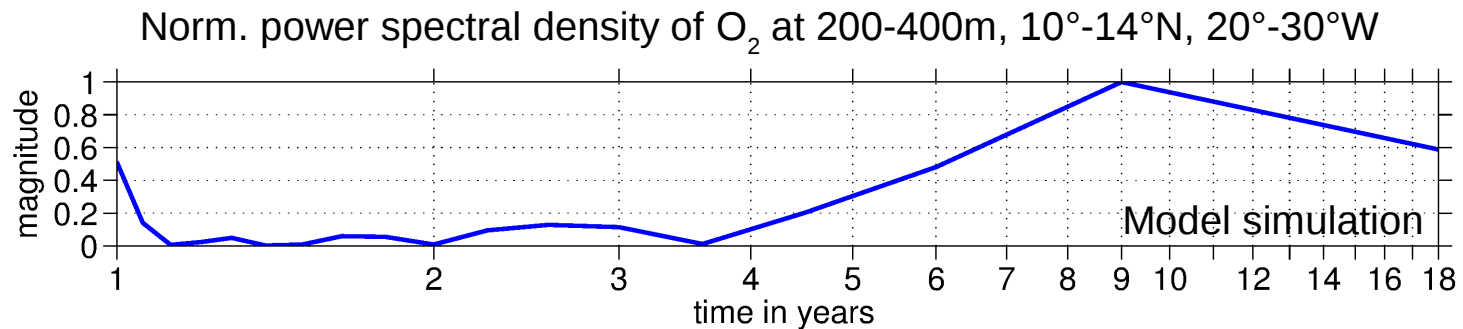
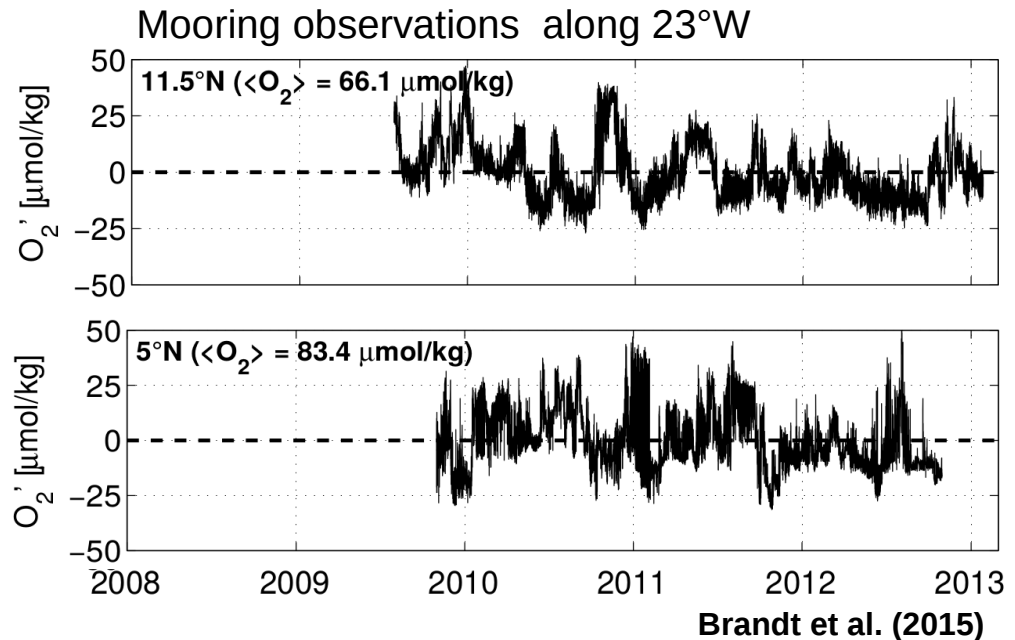
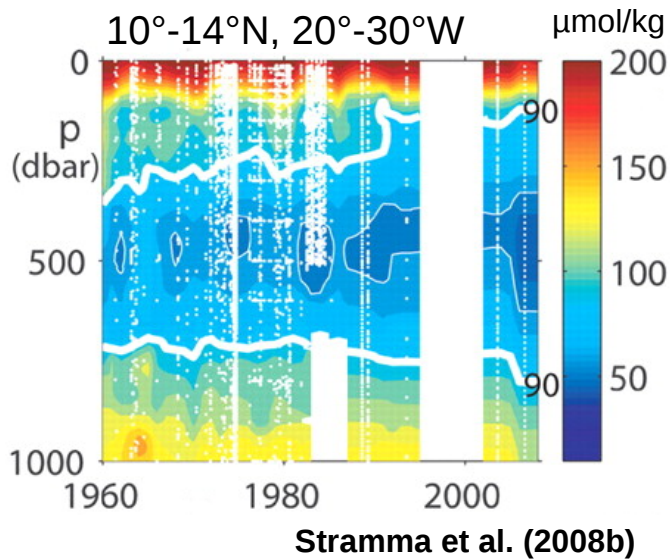
1999-2008



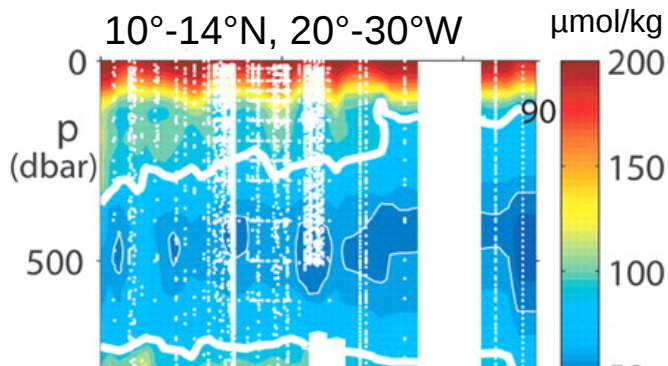
→ Main oxygen supply for OMZ by NEUC and nNECC
(Stramma et al., 2008a)



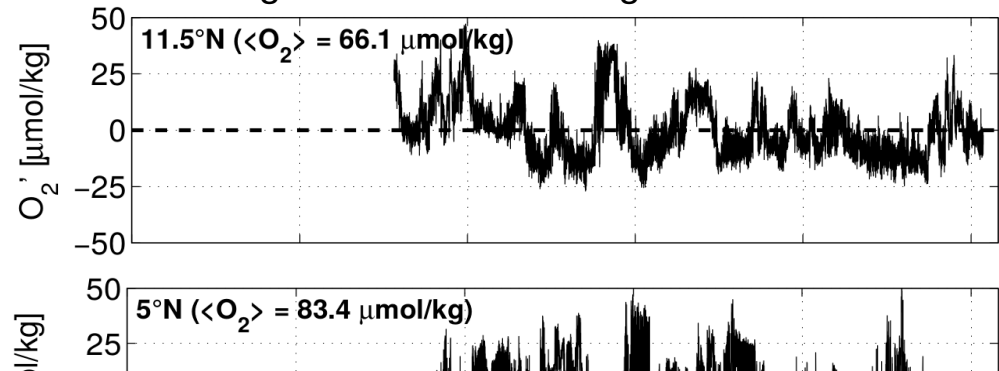
Oxygen variability



Oxygen variability

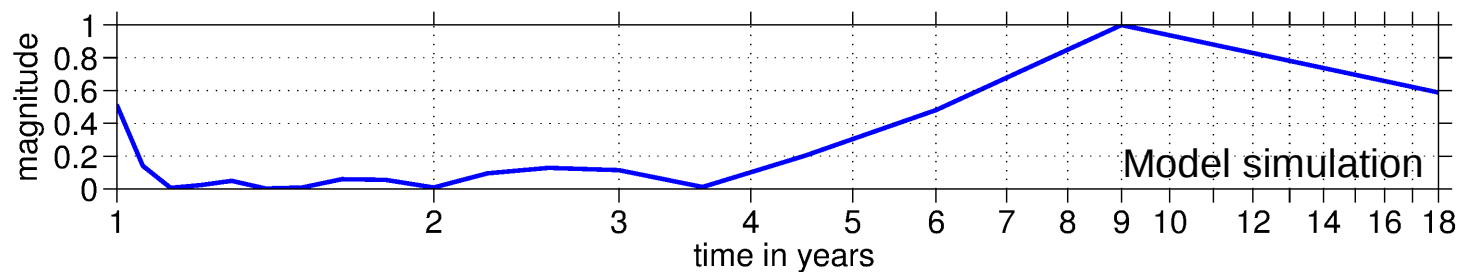


Mooring observations along 23°W



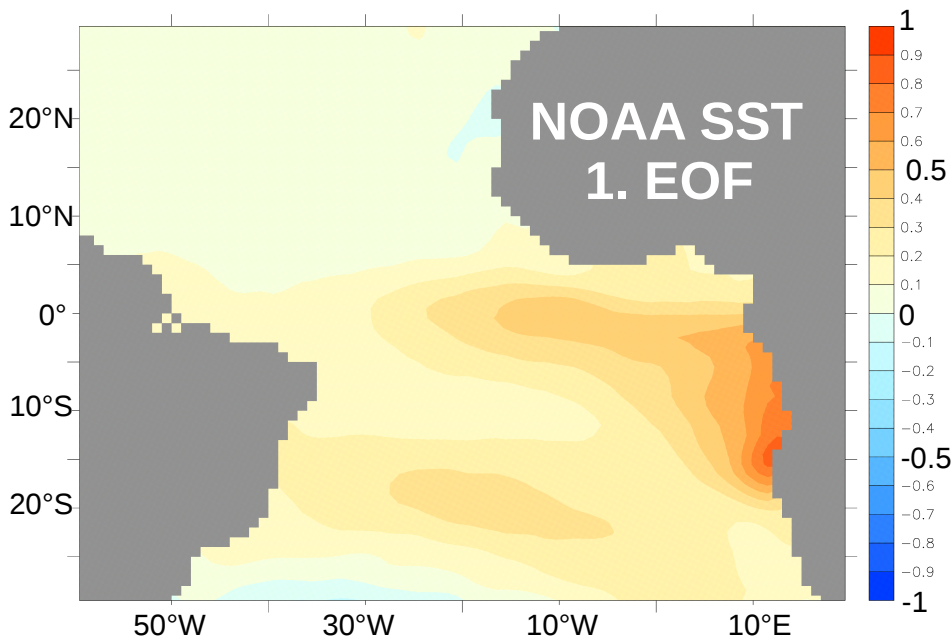
→ Long-term trend modulated by variability on various time scales

Norm. power spectral density of O_2 at 200-400m, 10°-14°N, 20°-30°W



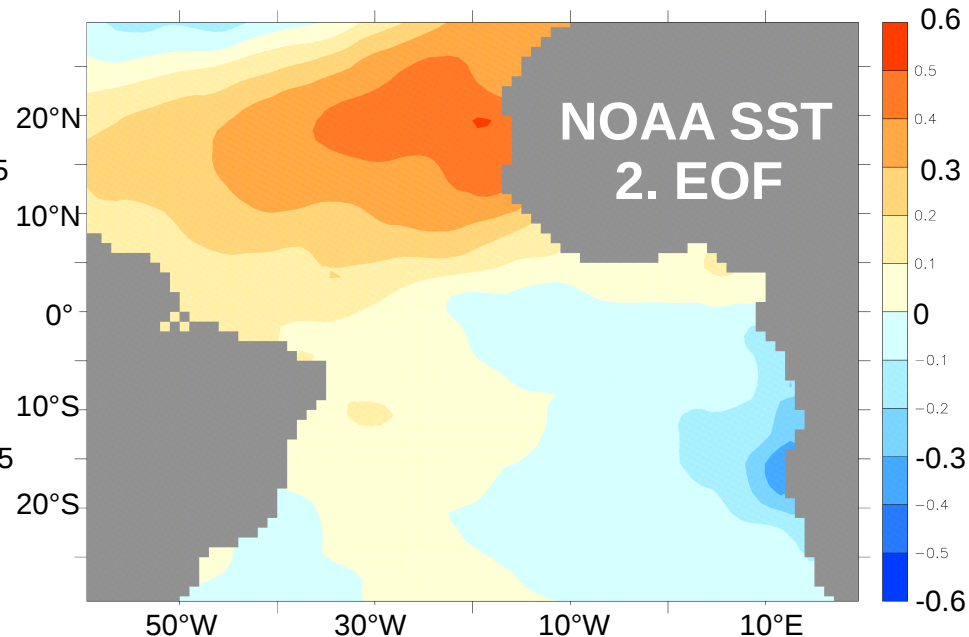
Introduction: The Atlantic zonal and meridional mode

Atlantic zonal mode (AZM)



- Peaks in June to August
- Interannual time scale
- Mainly governed by ocean dynamics

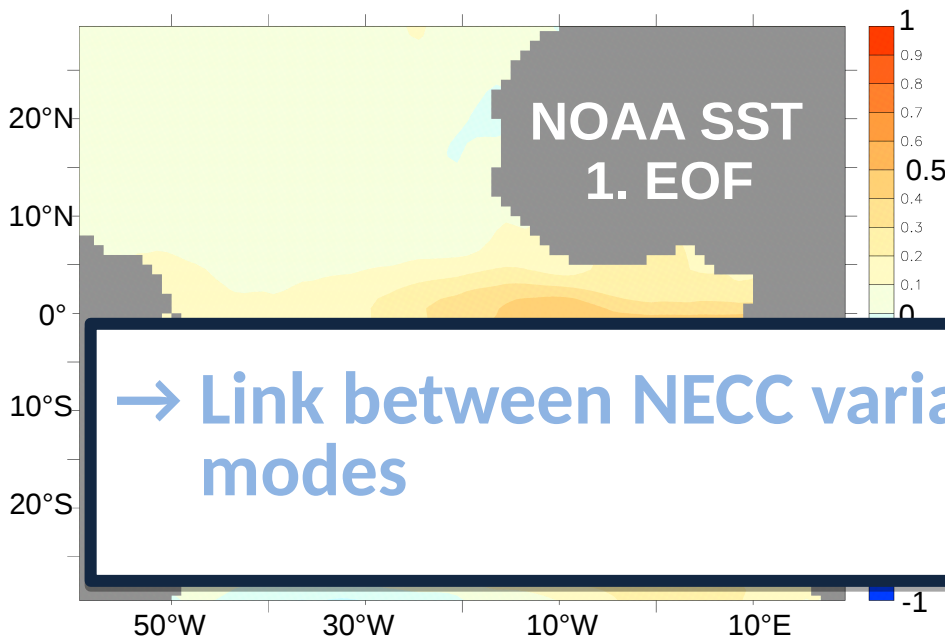
Atlantic meridional mode (AMM)



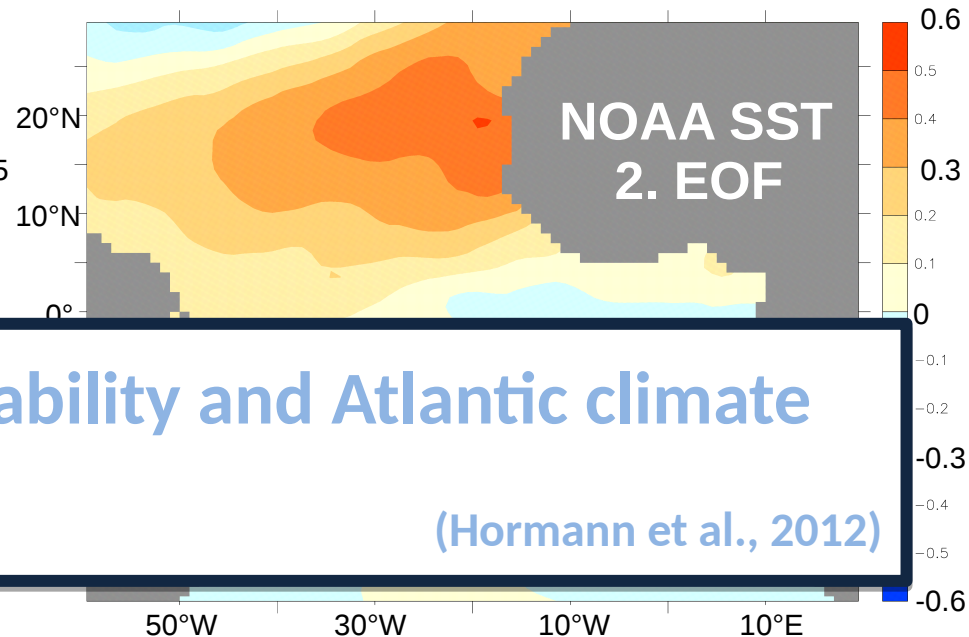
- Peaks in March to May
- Decadal time scale
- Mainly governed by thermodynamics

Introduction: The Atlantic zonal and meridional mode

Atlantic zonal mode (AZM)



Atlantic meridional mode (AMM)



→ Link between NECC variability and Atlantic climate modes

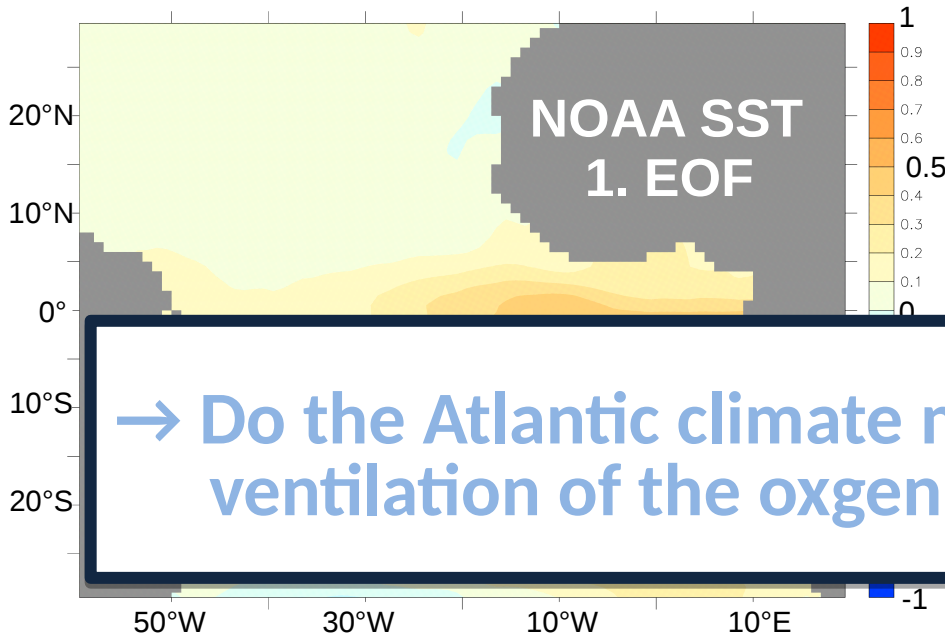
(Hormann et al., 2012)

- Peaks in June to August
- Interannual time scale
- Mainly governed by ocean dynamics

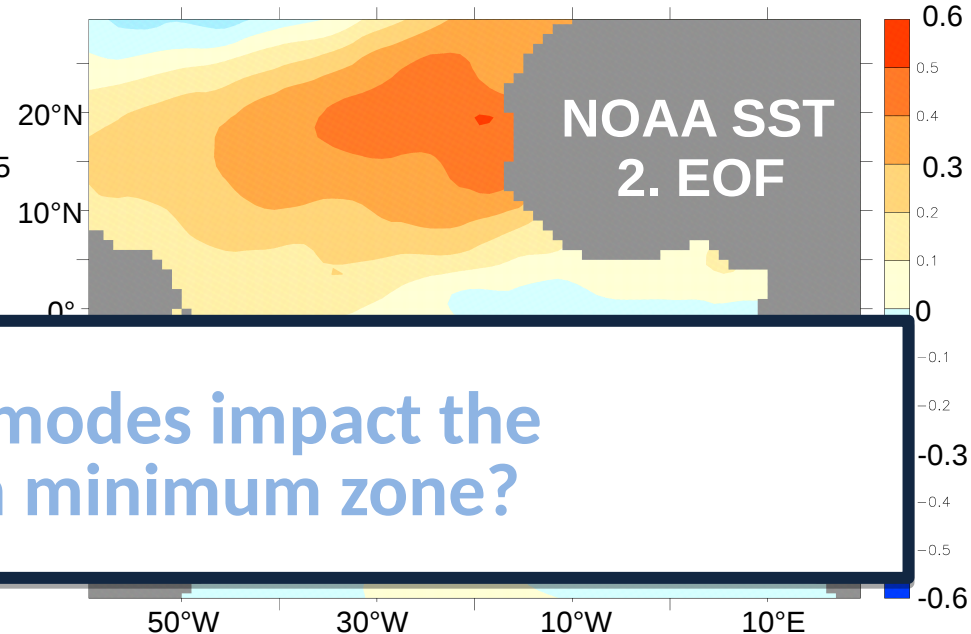
- Peaks in March to May
- Decadal time scale
- Mainly governed by thermodynamics

Introduction: The Atlantic zonal and meridional mode

Atlantic zonal mode (AZM)



Atlantic meridional mode (AMM)

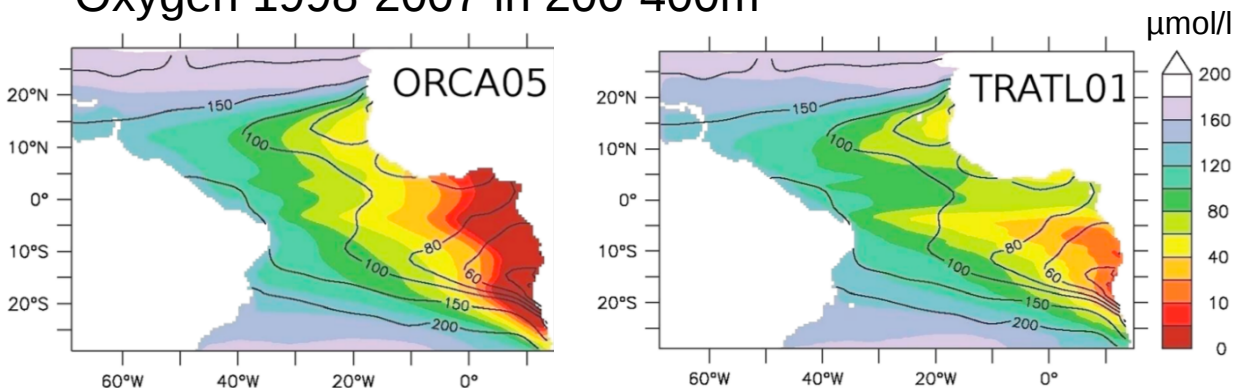


→ Do the Atlantic climate modes impact the ventilation of the oxygen minimum zone?

- Peaks in June to August
- Interannual time scale
- Mainly governed by ocean dynamics

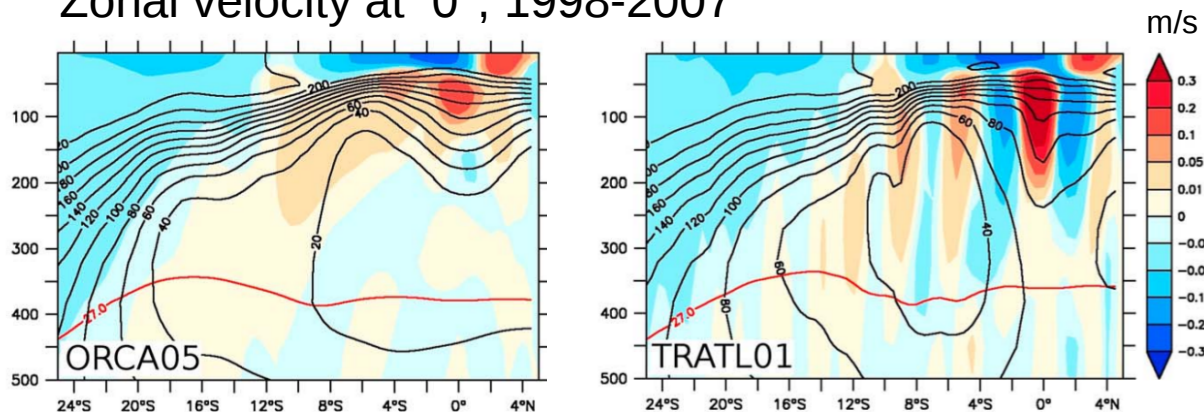
- Peaks in May to March
- Decadal time scale
- Mainly governed by thermodynamics

Oxygen 1998-2007 in 200-400m



Contours: O_2 in $\mu\text{mol/l}$ of World Ocean Atlas

Zonal velocity at 0° , 1998-2007



Black contours: O_2 in $\mu\text{mol/l}$

Red contour: 27.0 kg/m^3 isopycnals

Duteil et al. (2014)

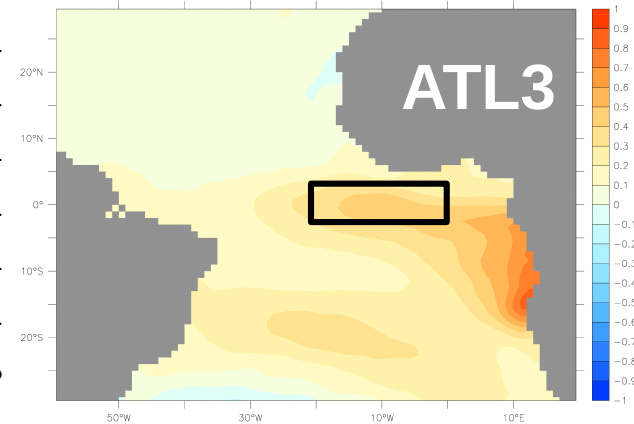
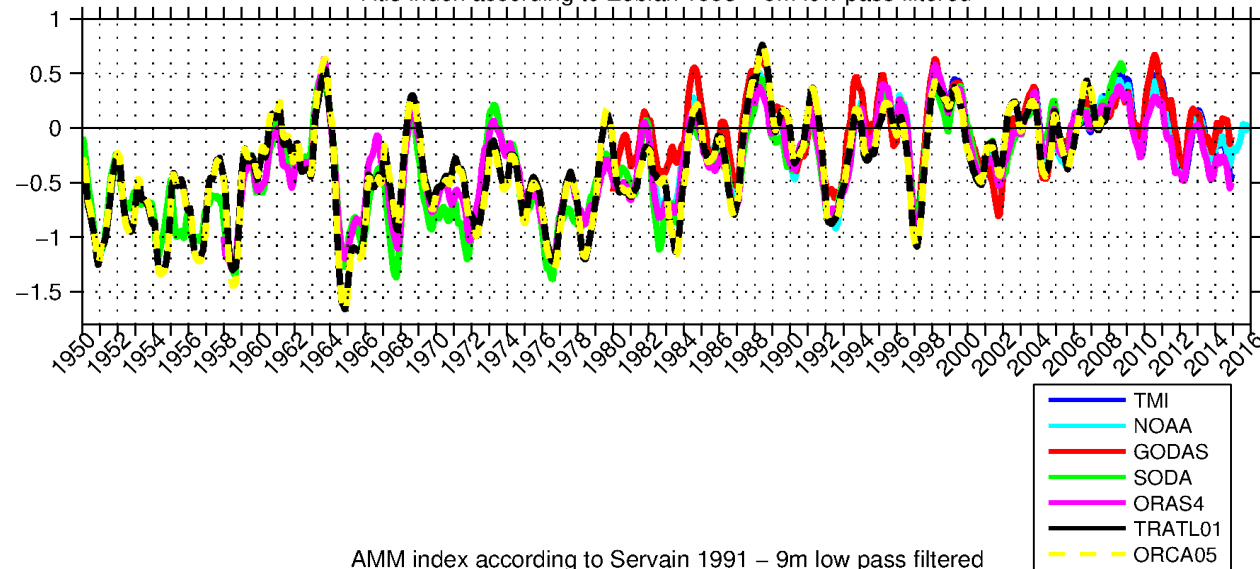
- Biogeochemical model coupled with high resolution ($1/10^\circ$) nested OGCM TRATL01 from 1958 to 2007 (Duteil et al., 2014)

in combination with

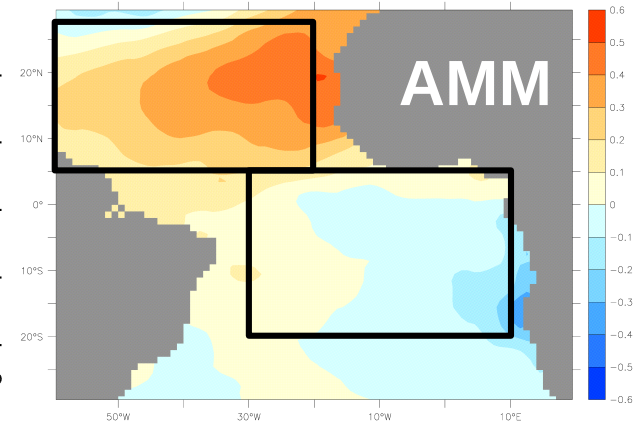
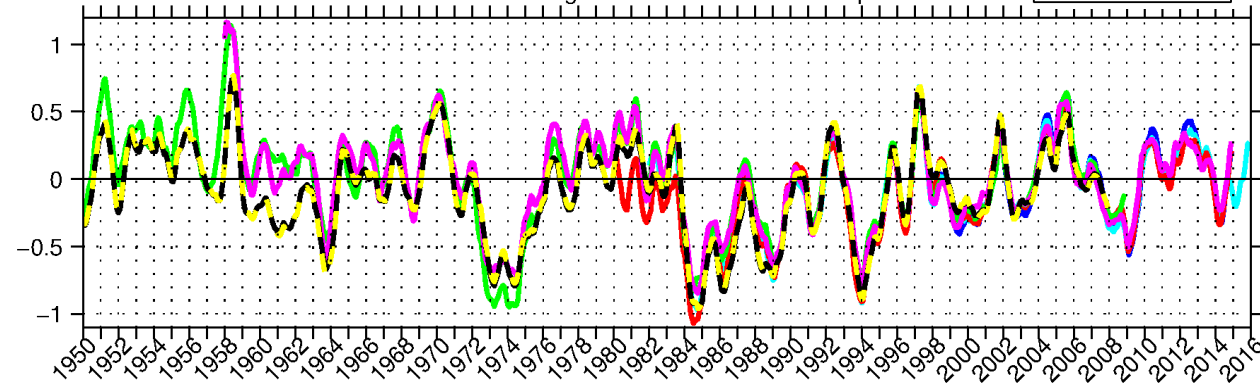
- Observational data (ship sections, moorings, satellite data)
- Reanalysis data (NOAA, GODAS, SODA, ORAS4)

Results: Indices of the Atlantic climate modes

Atl3 index according to Zebiak 1993 – 9m low pass filtered

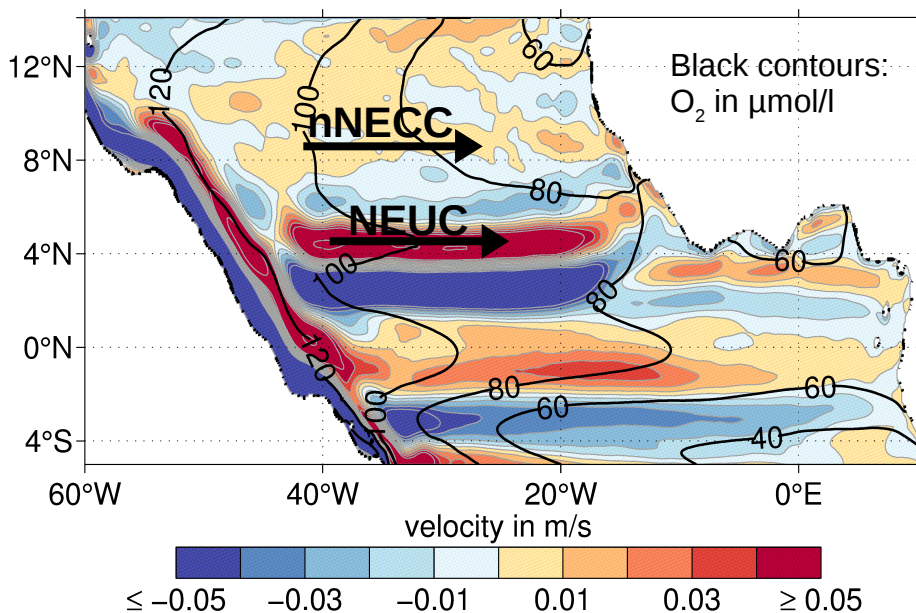


AMM index according to Servain 1991 – 9m low pass filtered

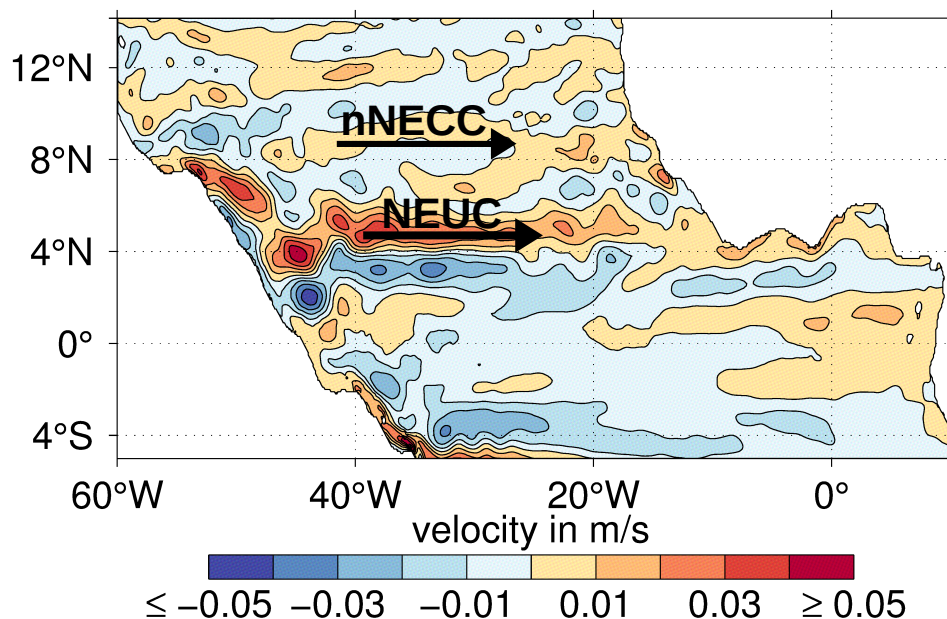


Oxygen and zonal velocity at 200-400m

Total mean 1998-2007

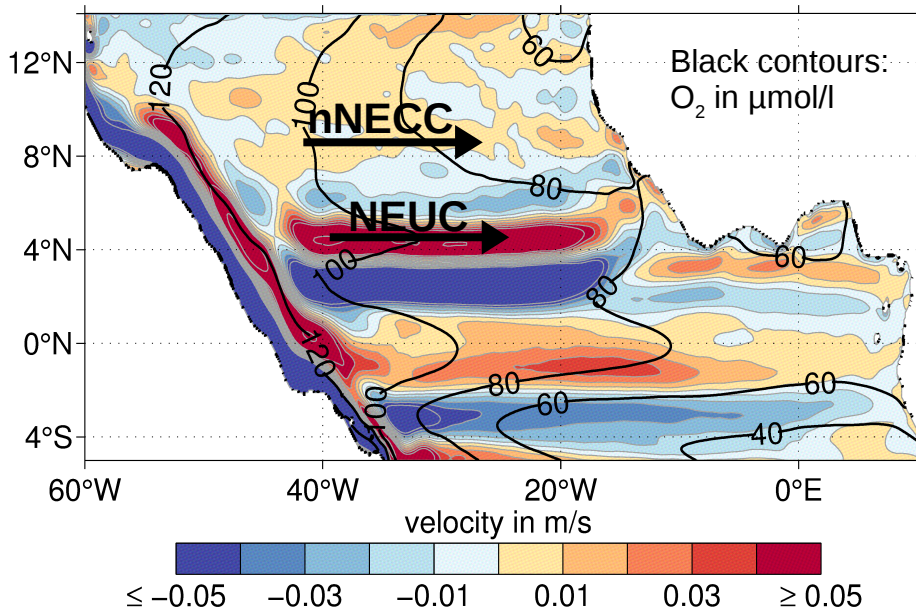


Positive minus negative AZM events

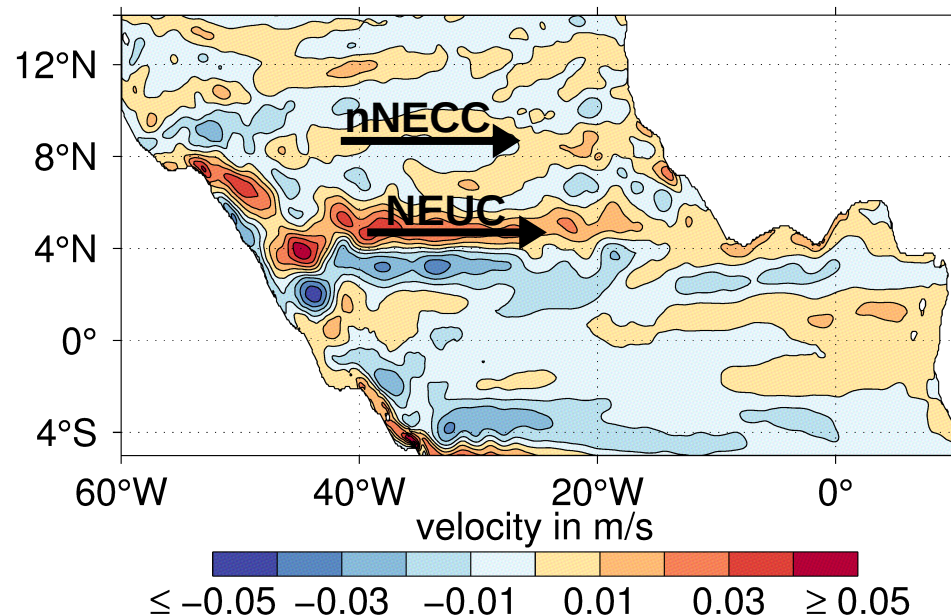


Oxygen and zonal velocity at 200-400m

Total mean 1998-2007



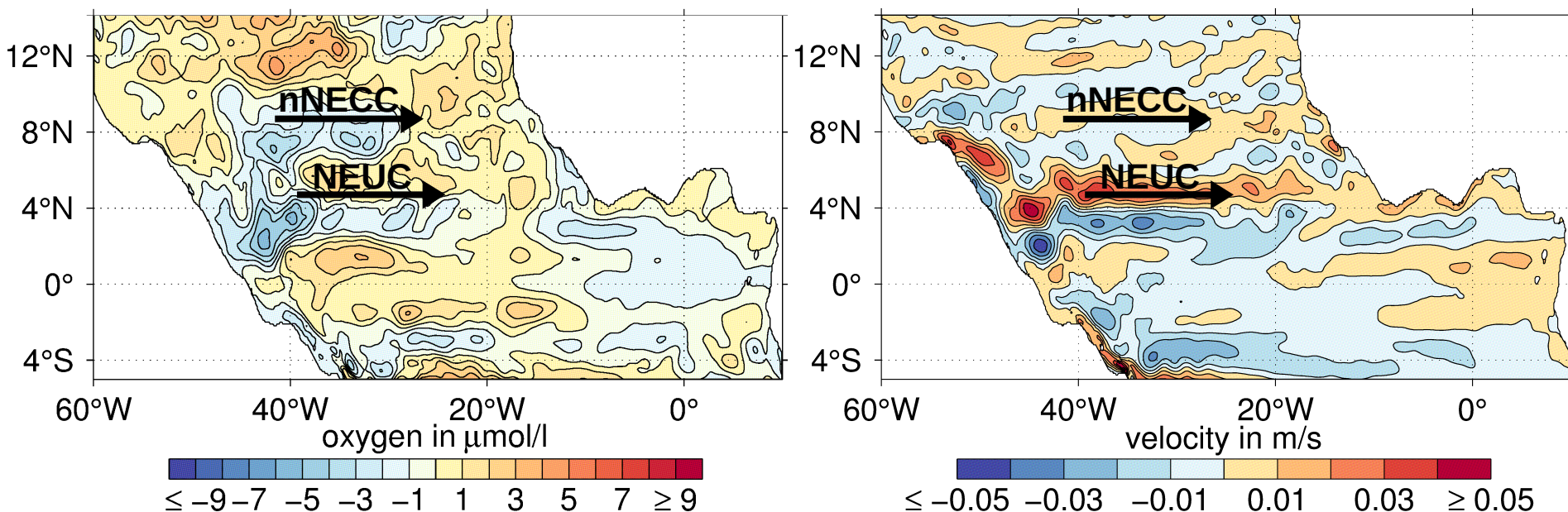
Positive minus negative AZM events



→ Stronger eastward flow at 4°N during positive AZM events compared to negative AZM events

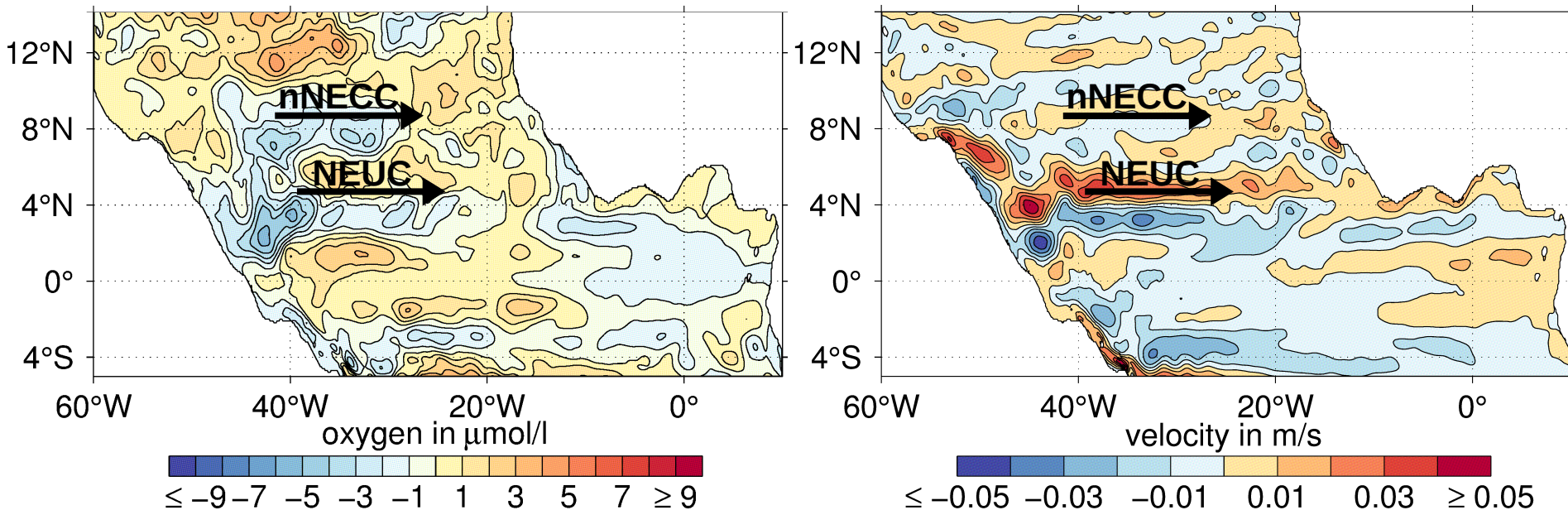
Oxygen and zonal velocity at 200-400m

Positive minus negative AZM events



Oxygen and zonal velocity at 200-400m

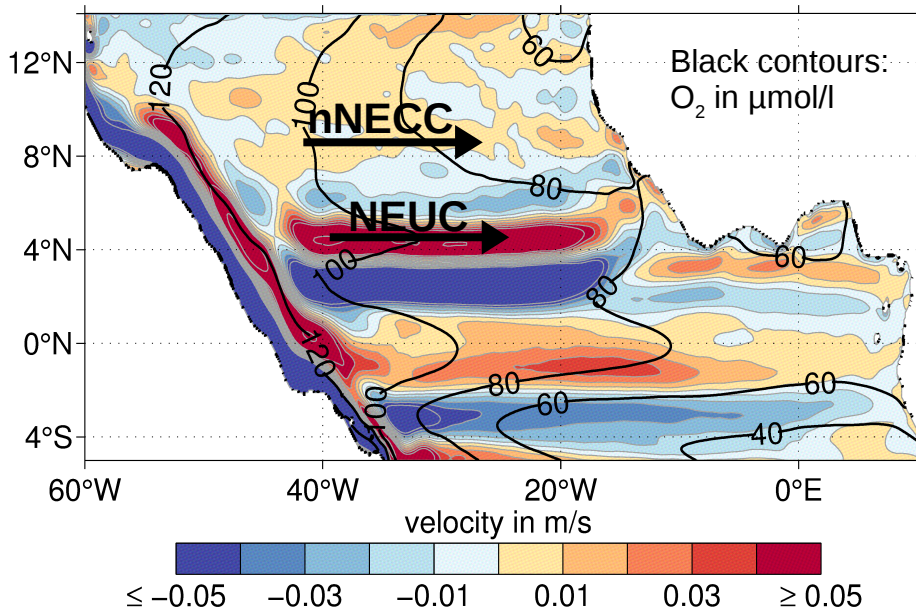
Positive minus negative AZM events



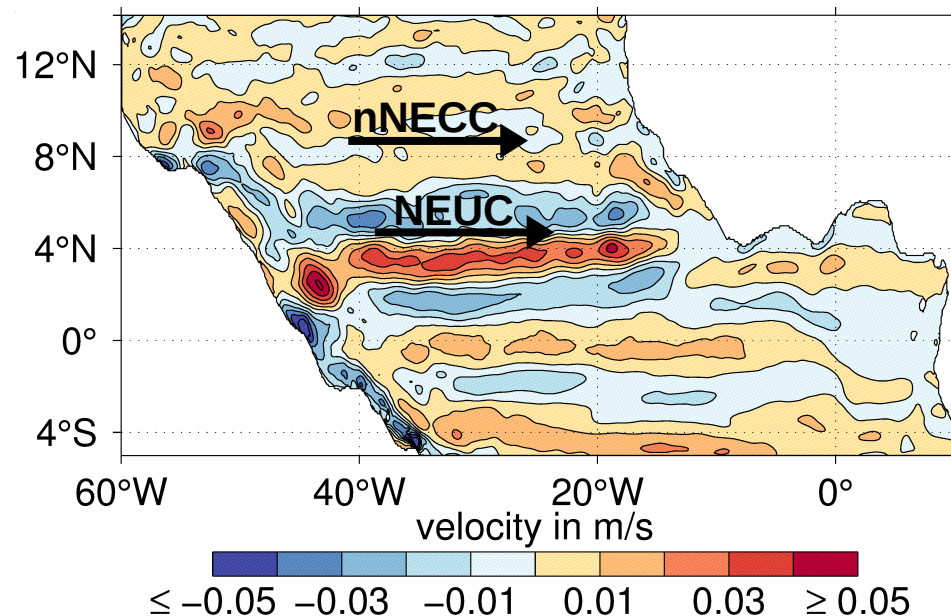
→ Positive velocity anomalies associated with positive oxygen anomalies and vice versa

Oxygen and zonal velocity at 200-400m

Total mean 1998-2007

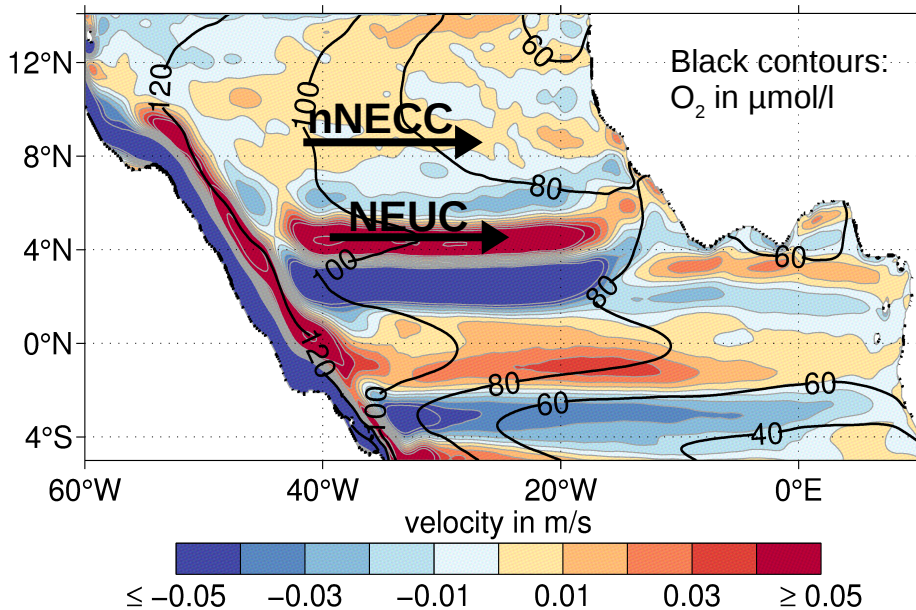


Positive minus negative AMM events

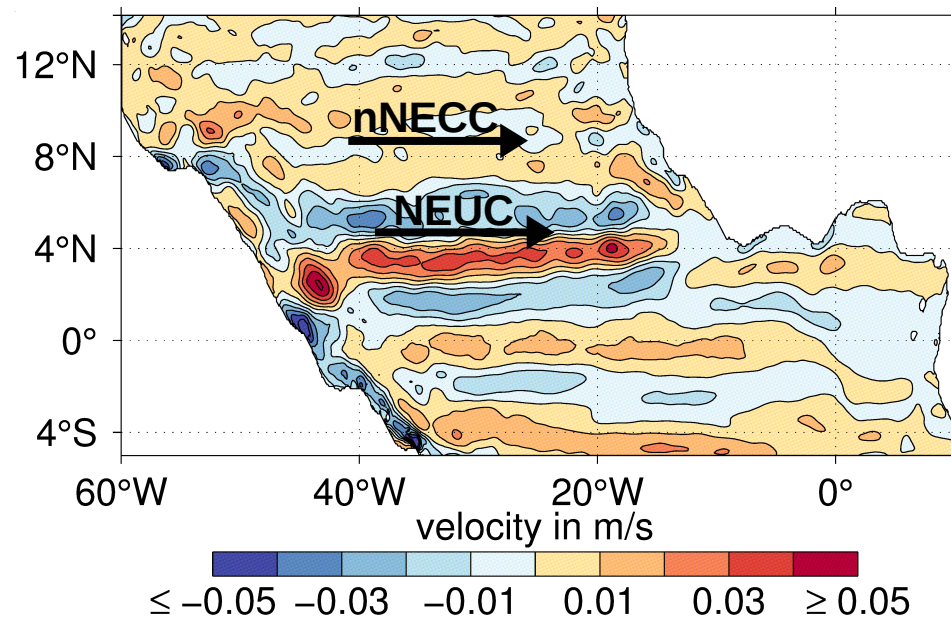


Oxygen and zonal velocity at 200-400m

Total mean 1998-2007



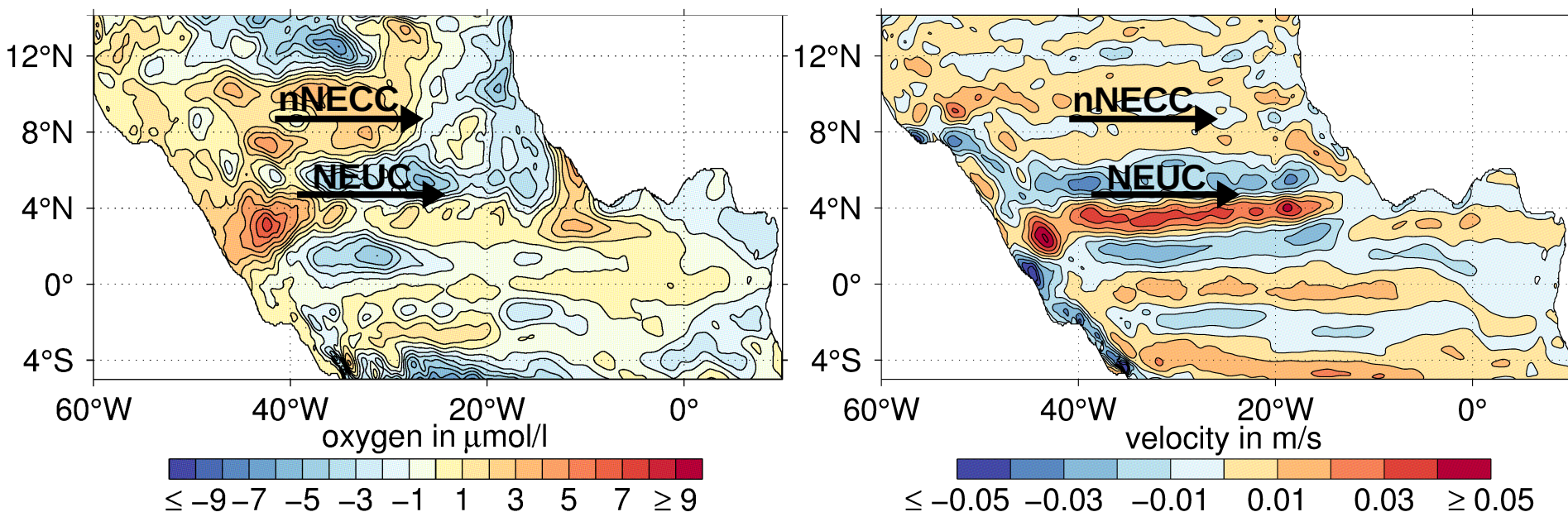
Positive minus negative AMM events



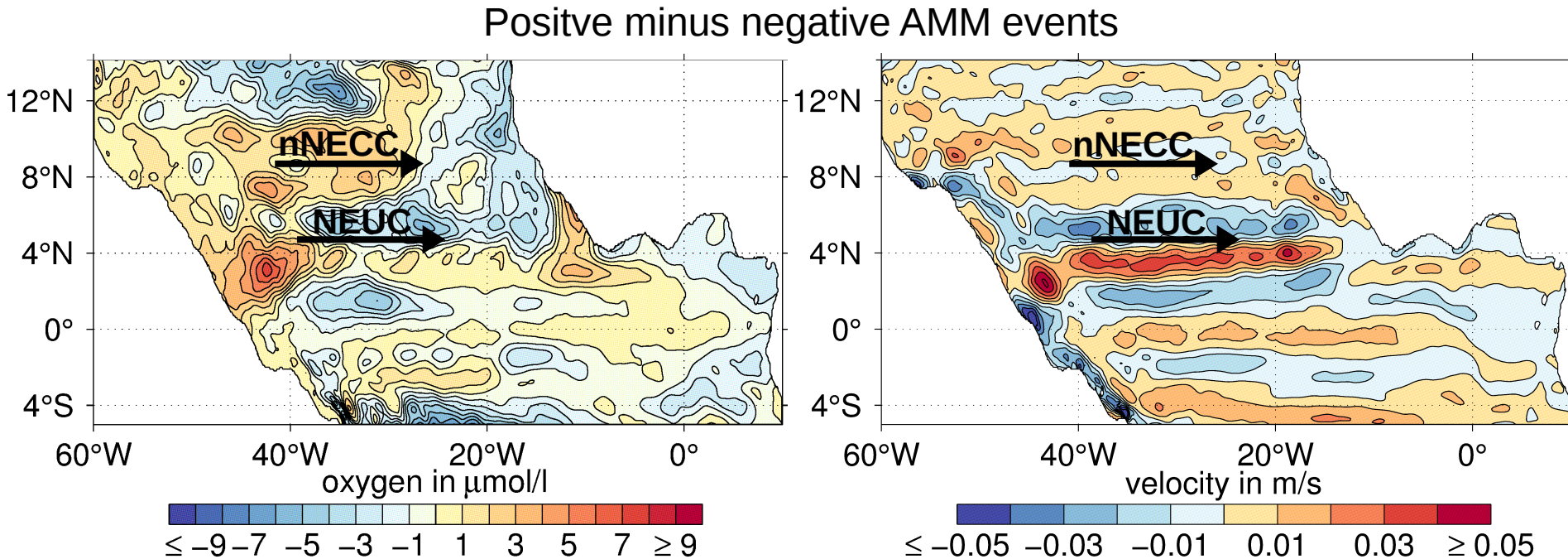
→ Northward shift of eastward flow at 4°N during negative AMM events compared to positive AMM events

Oxygen and zonal velocity at 200-400m

Positive minus negative AMM events



Oxygen and zonal velocity at 200-400m



→ Negative velocity anomalies associated with negative oxygen anomalies and vice versa

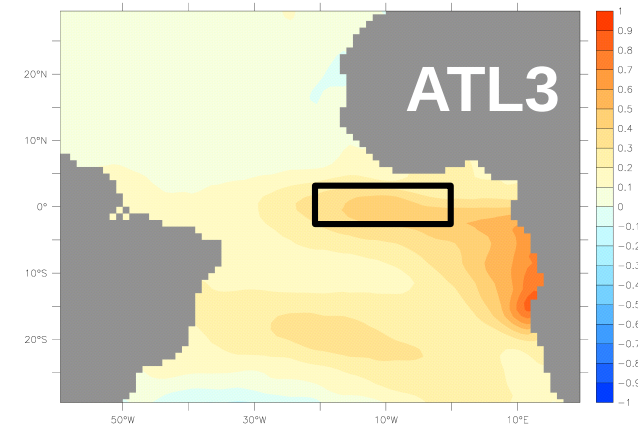
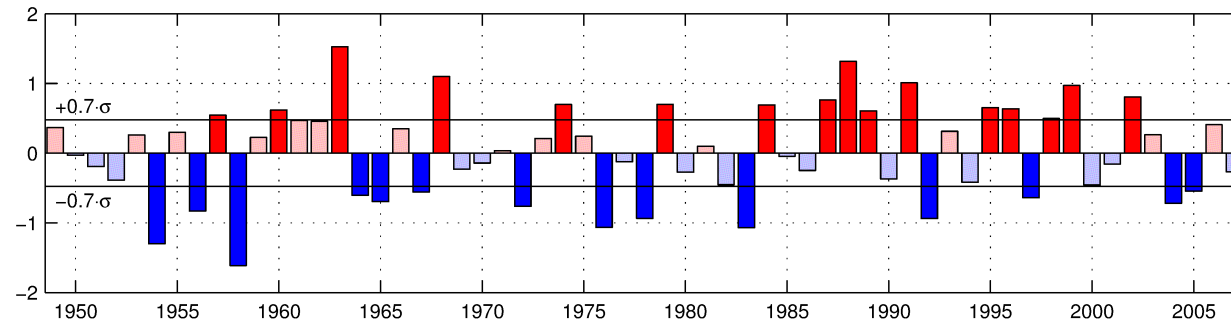
→ Link between oxygen and zonal current variability partly modulated by the Atlantic zonal and meridional mode

Outlook

- Compare to observational and reanalysis data
- Estimate core position and intensity of zonal current bands according to Johnson et al. (2002) and Hsin and Qiu (2012)
- Extend model simulation until 2016

Results: Indices of the Atlantic climate modes

TRATL01 – ALT3 JJA 1948–2007 – linear trend removed



TRATL01 – AMM MAM 1948–2007 – linear trend removed

